FEDERAL TEST METHOD STANDARD

PLASTICS - METHODS OF TESTING

SECTION 1

1. PURPOSE, SCOPE, AND CONTENTS

1.1 Purpose. This standard establishes methods for testing of plastics and may be used for the procurement of plastic materials under federal and military specifications and purchase contracts, where applicable. This standard may also be used in the preparation and revision of government specifications and other standardization documents.

1.2 Scope. This standard includes methods for measuring properties of plastics which are commonly determined. Methods for testing properties which are specific for end items and are not in general use, are not provided. These methods are given in specifications covering these end items. In case of conflict between the provisions of this standard and those of the specification or contract for a particular material, the provisions of the specification shall prevail.

1.3 Contents.

Section	Title
1.	Purpose, Scope, and Contents
2.	Numerical Index of ASTM Methods
3.	Numerical Index of Canceled Test Methods
4.	Alphabetical Index of Canceled Test Methods
5.	Numerical Index of Canceled Test Methods With No ASTM Method Replacements
6.	Numerical Index of Test Methods Retained From FTMS No. 406

1.4 Reference. ASTM publications are available for reference in most technical libraries, as well as some public libraries. They may be obtained from The American Society for Testing and Materials, 1916 Race St., Philadelphia, PA 19103.

SECTION 2

NUMERICAL INDEX OF ASTM METHODS

NOTE: There generally is a difference between the ASTM method and the method specified herein, although in some cases the methods are technically identical.

Superseding ASTM Standard		Superseded
Number	Title	Method(s) in FTMS No. 406
B117	Salt Spray (Fog) Testing	6071
B287	Acetic Acid - Salt Spray (Fog) Testing	6071
C613	Resin Content of Carbon & Graphite Prepregs by Solvent Extraction	7061
D149	Dielectric Breakdown Voltage & Dielectric Strength of Electrical Insulating Materials at Commercial Power Frequencies	4031
D150	A-C Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials	4021, 4042
D229	Rigid Sheet and Plate Materials Used for Electrical Insulation	1111
D256	Impact Resistance of Plastics & Electrical Insulating Materials	1071
D257	D-C Resistance or Conductance of Insulating Materials	4041, 4052
D494	Acetone Extraction of Phenolic Molded or Laminated Products	7021
D495	High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation	4011
D523	Specular Gloss	3051
D542	Index of Refraction of Transparent Organic Plastics	3011
D543	Resistance of Plastics to Chemical Reagents	7011
D568	Rate of Burning and/or Extent and Time of Burning of Flexible Plastics in a Vertical Position	2022
D569	Measuring the Flow Properties of Thermoplastic Molding Materials	2041
D570	Water Absorption of Plastics	7031
D617	Punching Quality of Phenolic Laminated Sheets	5031

Section 2. Numerical Index of ASTM Methods (Continued)

Superseding ASTM Standard Number	Title	Superseded Method(s) in FTMS No. 406
D621	Deformation of Plastics Under Load	1101
D635	Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position	2021
D637	Surface Irregularities of Flat Transparent Plastic Sheets	3041
D638	Tensile Properties of Plastics	1011
D644	Moisture Content of Paper and Paperboard by Oven Drying	7041
D648	Deflection Temperature of Plastics Under Flexural Load	2011
D651	Tensile Strength of Molded Electrical Insulating Materials	1012
D671	Flexural Fatigue of Plastics by Constant-Amplitude-of-Force	1061, 1062
D673	Mar Resistance of Plastics	1093
D695	Compressive Properties of Rigid Plastics	1021
D696	Coefficient of Linear Thermal Expansion of Plastics	2031, 2032
D726	Resistance of Paper to Passage of Air	5021
D732	Shear Strength of Plastics by Punch Tool	1041
D746	Brittleness Temperature of Plastics and Elastomers by Impact	2051
D756	Weight and Shape Changes of Plastics Under Accelerated Service Conditions	6011
D785	Rockwell Hardness of Plastics & Electrical Insulating Materials	1081
D790	Flexural Properties of Plastics & Electrical Insulating Materials	1031
D792	Specific Gravity & Density of Plastics by Displacement	5011, 5012
D793	Short-Time Stability at Elevated Temperatures of Plastics Containing Chlorine	7051
D882	Tensile Properties of Thin Plastic Sheeting	1013
D953	Bearing Strength of Plastics	1051
D1003	Haze & Luminous Transmittance of Transparent Plastics	3022
D1004	Initial Tear Resistance of Plastic Film and Sheeting	1121
D1044	Resistance of Transparent Plastic Materials to Surface Abrasion	1091, 1092

Section 2. Numerical Index of ASTM Methods (Continued)

Superseding ASTM Standard Number	Title	Superseded Method(s) in FTMS No. 406
D1203	Loss of Plasticizer from Plastics (Activated Carbon Methods)	6081
D1204	Linear Dimensional Changes of Nonrigid Thermoplastic Sheeting or Film at Elevated Temperature	2032
D1435	Outdoor Weathering of Plastics	6024
D1494	Diffuse Light Transmission Factor of Reinforced Plastics Panels	3032
D1502	Transverse Load of Corrugated Reinforced Plastic Panels	1032
D1893	Blocking of Plastic Film	1131
D2240	Rubber Property - Durometer Hardness	1082, 1083, 1084
D2863	Measuring the Minimum Oxygen Concentration To Support Candle-like Combustion of Plastics (Oxygen Index)	2023
D2990	Tensile, Compressive, and Flexural Creep and Creep-Rupture of Plastics	1063
D3029	Impact Resistance of Rigid Plastic Sheeting or Parts by Means of a Tup (Falling Weight)	1074
D3846	In-Plane Shear Strength of Reinforced Plastics	1042
E96	Water Vapor Transmission of Materials	7032
E167	Goniophotometry of Objects and Materials	3031
G21	Resistance of Synthetic Polymeric Materials to Fungi	6091
G23	Operating Light-Exposure Apparatus (Carbon-Arc Type) with and without Water for Exposure of Nonmetallic Materials	6022
G43	Acidified Synthetic Sea Water (Fog) Testing	6071

SECTION 3

NUMERICAL INDEX OF CANCELED TEST METHODS

NOTE: There may be a difference between the ASTM method and the method specified herein, although in some cases the methods are technically identical.

Superseded Method in FTMS NO. 406		Superseding ASTM Standard(s)
Number	Title	
	Mechanical Tests	
1011	Tensile Properties of Plastics	D638
1012	Tensile Strength of Molded Electrical Insulating Materials	D651
1013	Tensile Properties of Thin Plastic Sheets and Films	D882
1021	Compressive Properties of Rigid Plastics	D695
1031	Flexural Properties of Plastics	D790
1032	Transverse Load of Corrugated Reinforced Plastic Panels	D1502
1041	Shear Strength (Double Shear)	D732
1042	Interlaminar and Secondary Bond Shear Strength of Structural Plastic Laminates	D3846
1051	Bearing Strength	D953
1061	Constant-Strain Flexural Fatigue Strength	D671
1062	Constant-Stress Flexural Fatigue Strength	D671
1063	Tensile Time-Fracture and Creep	D2990
1071	Izod Impact Strength	D256
1074	Falling Ball Impact Test	D3029
1081	Rockwell Indentation Hardness Test	D785
1082	Indentation Hardness of Nonrigid Plastics by Means of a Durometer	D2440
1083	Indentation Hardness of Rigid Plastics by Means of a Durometer	D2440
1084	Calibration of Durometers Type "A" and Type "D"	D2240
1091	Abrasion Wear (Loss in Weight)	D1242
1092	Surface Abrasion	D1044
1093	Mar Resistance	D673
1101	Deformation Under Load	D621
1111	Bonding Strength	D229
1121	Tear Resistance of Film and Sheeting	D1004
1131	Blocking	D1893

Section 3 Numerical Index of Canceled Test Methods (Continued)

Superseded Method in FTMS No. 406		Superseding ASTM
Number	Title	Standard(s)
	Thermal Tests	
2011	Deflection Temperature Under Load	D648
2021	Flammability of Plastics Over 0.50 Inch in Thickness	D635
2022	Flammability of Plastics 0.050 Inch and Under in Thickness	D568
2023	Flame Resistance	D2863
2031	Linear Thermal Expansion (Fused-Quartz Tube Method)	D696
2032	Thermal Expansion Test (Strip Method)	D696, D1204
2041	Flow Temperature Test for Thermoplastic Molding Materials	D569
2051	Brittleness Temperature of Plastics by Impact	D746
	Optical Tests	
3011	Index of Refraction	D54
3022	Luminous Transmittance and Haze of Transparent Plastics	D1003
3031	Light Diffusion	E167
3032	Diffuse Luminous Transmittance Factor of Reinforced Plastic Panels	D1494
3041	Optical Uniformity and Distortion	D637
3051	Gloss	D523
	Electrical Tests	
4011	Arc Resistance	D495
4021	Dissipation Factor and Dielectric Constant	D150
4031	Dielectric Breakdown Voltage and Dielectric Strength	D149
4041	Electrical Resistance (Insulation, Volume, Surface)	D257
4042	Volume Resistivity of Casting Resins	D150
4052	Electrical Insulation Resistance of Plastic Films and Sheets	D257

Section 3. Numerical Index of Canceled Test Methods (Continued)

Superseded Method in FTMS No. 406 Number	Title	Superseding ASTM Standard(s)
	Miscellaneous Physical Tests	
5011	Specific Gravity by Displacement of Water	D792
5012	Specific Gravity from Weight and Volume Measurements	D792
5021	Porosity	D726
5031	Punching Quality of Phenolic Laminated Sheets	D617
	Permanence Tests	
6011	Accelerated Service Tests (Temperature & Humidity Extremes)	D756
6022	Accelerated Weathering Test; Carbon Arc Without Filters, (Alternate Navy Test)	G23
6024	Resistance of Plastics to Artificial Weathering Using Fluorescent Sunlamp and Fog Chamber	D1435
6071	Salt-Spray Test	B117, B287
6081	Volatile Loss	G43
6091	Mildew Resistance of Plastics, Mixed Culture Method, Agar Medium	D1203 G21
	Chemical Tests	
7011	Resistance of Plastics to Chemical Reagents	D543
7021	Acetone Extraction Test (For Degree of Cure of Phenolics)	D494
7031	Water Absorption of Plastics	D570
7032	Water Vapor Permeability	E96
7041	Drying Test (For Weight Loss)	D644
7051	Short-Time Stability at Elevated Temperatures of Plastics Containing Chlorine	D793
7061	Resin in Inorganic-Filled Plastics	C613

SECTION 4
ALPHABETICAL INDEX OF CANCELED TEST METHODS

NOTE: There may be a difference between the ASTM method and the method specified herein although in some cases the methods are technically identical .

Superseded Method in FTMS No. 406		Superseding ASTM
Title	Number	Standard(s)
Abrasion Wear (Loss in Weight)	1091	D1242
Accelerated Service Tests (Temperature and Humidity Extremes)	6011	D756
Accelerated Weathering Test; Carbon Arc Without Filters, (Alternate Navy Test)	6022	G23
Acetone Extraction Test For Degree of Cure of Phenolics	7021	D494
Arc Resistance	4011	D495
Bearing Strength	1051	D953
Blocking	1131	D1893
Bonding Strength	1111	D229
Brittleness Temperature of Plastics By Impact	2051	D746
Calibration of Durometers Type "A" and Type "D"	1084	D2240
Compressive Properties of Rigid Plastics	1021	D695
Constant-Strain Flexural Fatigue Strength	1061	D671
Constant-Stress Flexural Fatigue Strength	1062	D671
Deflection Temperature Under Load	2011	D648
Deformation Under Load	1101	D621
Dielectric Breakdown Voltage and Dielectric Strength	4031	D149
Diffuse Luminous Transmittance Factor of Reinforced Plastic Panels	3032	D1494
Dissipation Factor and Dielectric Constant	4021	D150
Drying Test (For Weight Loss)	7041	D644
Electrical Insulation Resistance of Plastic Films and Sheets	4052	D257
Electrical Resistance (Insulation, Volume, Surface)	4041	D257
Falling Ball Impact Test	1074	D3029
Flame Resistance	2023	D2863
Flammability of Plastics 0.050 Inch and Under In Thickness	2022	D568
Flammability of Plastics Over 0.050 Inch in Thickness	2021	D635
Flexural Properties of Plastics	1031	D790
Flow Temperature Test for Thermoplastic Molding Materials	2041	D569
Gloss	3051	D523

Section 4. Alphabetical Index of Canceled Test Methods (Continued)

Superseded Method in FTMS No. 406 Title	Superseding Number	Superseding ASTM Standard(s)
Indentation Hardness of Nonrigid Plastics by Means of a Durometer	1082	D2240
Indentation Hardness of Rigid Plastics by Means of a Durometer	1083	D2240
Index of Refraction	3011	D542
Interlaminar and Secondary Bond Shear Strength of Structural Plastic Laminates	1042	D3846
Izod Impact Strength	1071	D256
Light Diffusion	3031	E167
Linear Thermal Expansion (Fused-Quartz Tube Method)	2031	D696
Luminous Transmittance and Haze of Transparent Plastics	3022	D1003
Mar Resistance	1093	D673
Mildew Resistance of Plastics, Mixed Culture Method, Agar Medium	6091	G21
Optical Uniformity and Distortion	3041	D637
Porosity	5021	D726
Punching Quality of Phenolic Laminated Sheets	5031	D617
Resin in Inorganic-Filled Plastics	7061	C613
Resistance of Plastics to Artificial Weathering Using Fluorescent Sunlamp and Fog Chamber	6024	D1435
Resistance of Plastics to Chemical Reagents	7011	D543
Rockwell Indentation Hardness Test	1081	D785
Salt-Spray Test	6071	B287, B117
Shear Strength (Double Shear)	1041	D732
Short-Time Stability at Elevated Temperatures of Plastics Containing Chlorine	7051	D793
Specific Gravity by Displacement of Water	5011	D792
Specific Gravity from Weight and Volume Measurements	5012	D792
Surface Abrasion	1092	D1044
Tear Resistance of Film and Sheeting	1121	D1004
Tensile Properties of Plastics	1011	D638
Tensile Properties of Thin Plastic Sheets and Films	1013	D882
Tensile Strength of Molded Electrical Insulating Materials	1012	D651
Tensile Time-Fracture and Creep	1063	D2990
Thermal Expansion Test (Strip Method)	2032	D696, D1204
Transverse Load of Corrugated Reinforced Plastic Panels	1032	D1502
Volatile Loss	6081	D1203
Volume Resistivity of Casting Resins	4042	D150
Water Absorption of Plastics	7031	D570
Water Vapor Permeability	7032	E96

SECTION 5

NUMERICAL INDEX OF CANCELED TEST METHODS WITH NO ASTM METHOD REPLACEMENTS

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Canceled FTMS No. 406 Method Number	Canceled FTMS No. 406 Method Title
1072	Shockproofness
1073	Shatterproofness
1075	Shatterproofness (Gage Windows)
5041	Machineability
6031	Colorfastness to Light
6052	Internal Stress in Plastic Sheet
6054	Warpage of Sheet Plastics
6061	Hot Oil Bath Test
6062	Effect of Hot Hydrocarbons on Surface Stability

SECTION 6

NUMERICAL INDEX OF TEST METHODS RETAINED
FROM FTMS NO. 406

Federal Standard Method Title	Federal Standard Method Number
Accelerated Weathering Test: Soaking, Freezing, Drying, Ultraviolet Cycle (Alternate Navy Test)	6023
Delamination	6041
Warpage	6051
Crazing Resistance Under Stress	6053
Determining The Corrosivity Index (Water Extract Conductance) of Plastics and Fillers	7071
Compatibility of Plastic-Explosive Mixtures	7081

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ACCELERATED WEATHERING TEST: SOAKING, FREEZING, DRYING, ULTRAVIOLET CYCLE

1. SCOPE

1.1 Scope. These methods are designed for use in determining the effects of cycles of soaking, freezing, drying, and exposure to ultraviolet light upo plastic articles. They cover procedures for determining weight and dimensional changes occurring in plastics exposed to a given set of heat, moisture, and ultraviolet conditions.

2. TEST SPECIMENS

2.1 Dimensions. The test specimens may be of any size which can be conveniently prepared and tested.

2.2 Specimen Preparation. The specimens shall be weighed and significant dimensions measured.

3. APPARATUS

3.1 Balance. A balance capable of weighing accurately to 0.05 percent a test specimen weighing 100 grams or less, and to 0.1 percent a test specimen weighing over 100 grams is required.

3.2 Oven. A circulating-air oven capable of maintaining the temperature o test within $\pm$ 2°C (3.6°F) is required.

3.3 Containers. Noncorroding containers with a shelf to support the test specimen above the water used for maintaining the humidity is required. The container shall be tightly sealed except for a small capillary which permits release of vapor pressure that might otherwise lift the top off the container. Each test specimen shall be tested preferably in a separate container.

3.4 Desiccator. A clean, dry, uncharged desiccator or equivalent closed container in which to bring test specimens to room temperature is required.

3.5 Absorbent cloth. Clean, nonlinting absorbent cloth for use in wiping exudation or condensed moisture from test specimens is required.

3.6 Micrometer. A micrometer capable of measuring dimensions of test specimens to 0.001 in is required.

3.7 Cold box. A cold box capable of maintaining the temperature of test within ± 3°C (5.4°F) is required.

3.8 Psychrometer. A wet and dry-bulb psychrometer or other suitable device capable of measuring the relative humidity of atmospheric air is required.

3.9 Ultraviolet light. A source of ultraviolet radiation is required.

4. PROCEDURE

4.1 Conditioning. The specimens shall be conditioned at 23 ± 1.1°C (73.5 ± 2°F) and 50 ± 4 percent relative humidity prior to the test, the conditioning period prior to test shall be 48 hours for specimens of 1/8 in (3mm) or less in thickness and 96 hours for thicker specimens.

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4.2 Exposure cycle. The specimens shall then be subjected to the following accelerated weathering test procedure:

24 hours at 38°C (100°F) over water
(about 100 percent relative humidity)
4 hours at -57°C (-70°F)
16 hours at 71°C (160°F) in a circulating air oven
4 hours exposure to ultraviolet radiation

4.3 Repeated cycles. To simulate the effect of repeated exposure, schedules involving the use of repeated cycles of the conditions in 4.2 may be specified. At the conclusion of the specified exposure cycle or cycles, the test specimens shall be reconditioned and then weighed and measured. If determinations of weight and dimensions are made at the conclusion of various steps in the test, the specimens should be kept at 23 ± 0.5°C (73 ± 1°F) in a closed container for 10 minutes and then weighed and measured. Providing that changes in dimensions, structure, or shape have not destroyed their usefulness, appropriate standard test specimens may be subjected to physical tests after reconditioning to determine the effect of the accelerated service conditions on specified physical properties.

5. REPORT

5.1 Report. The report shall include the data specified in Appendix I (General Requirements) at the end of this section, and the following:

(1) Number of cycles employed.
(2) The percentage changes in weight and dimensions of the specimen after reconditioning and at any specified stages during the test cycles.
(3) Observations regarding any change in physical appearance of the specimen.
(4) The results of any physical tests made to determine the effect of the accelerated service conditions on the strength of the specimen.

METHOD 6041
January 4, 1982

DELAMINATION

1. SCOPE

1.1 Scope. This method is designed for use in determining the resistance of laminated plastics to delamination as a result of cycles of immersion in water followed by drying.

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2. TEST SPECIMENS

2.1 Dimensions. The specimen shall be 3 by 1 by 0.5 in (7.6 by 2.5 by 1.3 cm).

3. APPARATUS

3.1 Oven. A circulating-air oven capable of maintaining a temperature of 50 ± 2°C is required.

4. PROCEDURE

4.1 Testing cycle. The specimens shall be subjected to 8 hours immersion in water at 50°C followed by 16 hours in a circulating-air oven at 50°C. This cycle shall be completed 5 times. Upon completion of the fifth cycle the specimens shall be completely immersed in fresh water at room temperature for 1 hour and then dried in room ambient temperature. They shall be considered dry in 48 hours. The specimens shall be periodically inspected during the 48-hour drying period.

5. REPORT

5.1 Report. The report shall include the data specified in Appendix I (General Requirements) at the end of this section, and the following:

(1) Appearance and growth of visible cracks

METHOD 6051
January 4, 1982

WARPAGE

1. SCOPE

1.1 Scope. This method is designed for use in determining the extent of warpage or twist in full-sized sheets of plastics by measuring their deviation from a straight edge.

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2. TEST SPECIMENS

2.1 Dimensions. A full-sized, delivered sheet shall be tested.

3. APPARATUS

3.1 Micrometer. A straight edge and a dial micrometer, thickness gauge, or any similar device accurate to 0.001 inch is required.

4. PROCEDURE

4.1 Measurements. The warp or twist shall be determined by laying a straight edge along the dimension to be measured and measuring the greatest deviation by use of a metal scale. Sheets shall be suspended in a vertical position against a horizontal straight edge to measure warp. The twist shall be determined by suspending the sheet vertically from adjacent corners in succession and measuring the deviation along the diagonal from a horizontal straight edge.

4.2 Calculations. The warp or twist shall be taken as:

$$W = \frac{D \times 100}{L}$$

where:
W = the percentage warp or twist
D = the maximum deviation in inches
L = the length of the sheet in inches along the horizontal straight edge.

For comparing warp or twist in any length of sheets, the following formula may be used:

$$C = \frac{W \times 36}{L}$$

where:
C = the percentage warp or twist calculated for a 36-inch length

5. REPORT

5.1 Report. The report shall include the data specified in Appendix I (General Requirements) at the end of this section, and the following:

(1) Percentage warp or twist.

CRAZING RESISTANCE UNDER STRESS

1. SCOPE

1.1 Scope. This method is designed for use in determining the resistance of acrylic plastics to cracks or crazing under stress.

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2. TEST SPECIMENS

2.1 Dimensions. The specimen shall be 0.25 by 1 by 7 in (0.6 by 2.5 by 17.8 cm).

3. APPARATUS

3.1 Testing equipment. Equipment for loading the specimen as described in paragraph 4 and shown in figure 6053 is required.

3.2 Benzene. Benzene conforming to Federal Specification VV-B-231 is required.

4. PROCEDURE

4.1 Load. The specimen shall be set up as a class 1 lever with the fulcrum 2 in (5.0 cm) from the clamped end and a load of 2.6 lb (1.2 kg) suspended at a 4-in (10.2-cm) overhang from the fulcrum. This loading for the 4-in (10.2-c overhang and 0.25-in (0.6-cm) thick specimen produces an outer fiber stress of 1,000 psi (6.9 MPa) in the plastic at the fulcrum point.

4.2 Application of benzene. While the specimen is stressed, benzene shall be applied to the top surface of the plastic above the fulcrum point. The benzene shall be applied with a soft 0.5-in (1.2-cm) wide brush, wetted before each stroke. Ten individual strokes, at one second intervals, across the width of the specimen shall be required.

4.3 Examination. After thorough drying, the specimen shall be carefully examined for any evidence of surface defects, cracks, or crazing.

5. REPORT

5.1 Report. The report shall include the data specified in Appendix I (General Requirements) at the end of this section, and the following:

(1) The extent of defects, cracks, or crazing caused by the test

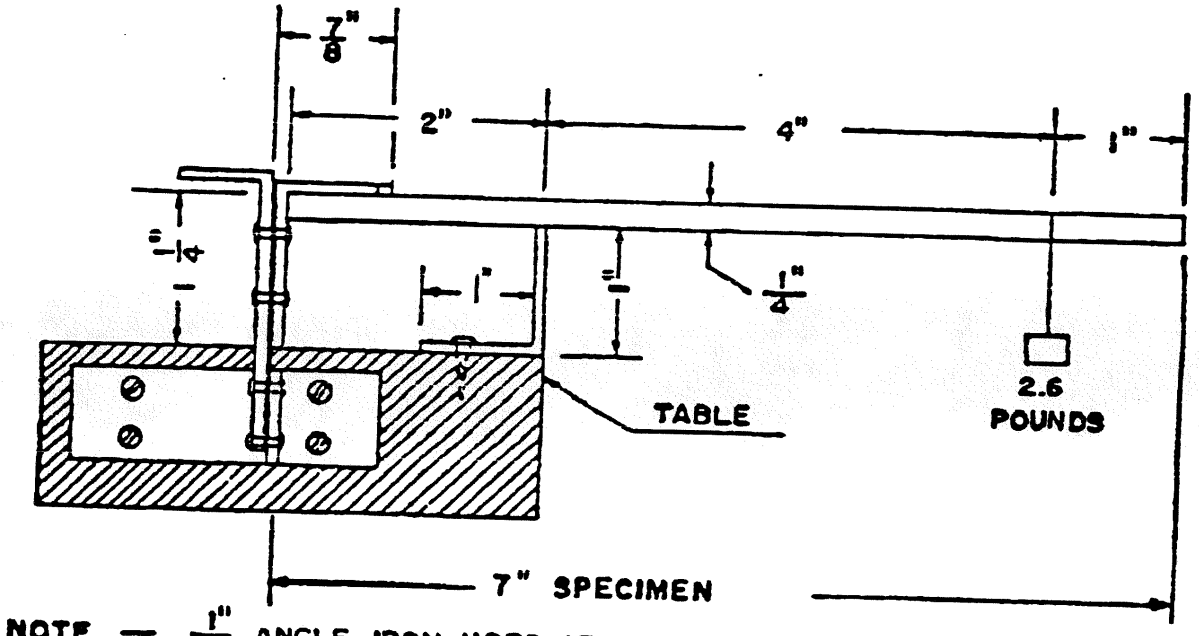

FIGURE 6053.—*Test set-up for crazing resistance of plastics under stress.*

This method is a part of Fed. Test Method Std. No. 406a

METHOD 7071
January 4, 1982

DETERMINING THE CORROSIVITY INDEX (WATER EXTRACT CONDUCTANCE) OF PLASTICS AND FILLERS

1. SCOPE

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1.1 Scope. This method is designed for obtaining the specific conductance of water extract of plastics and fillers. The magnitude of this conductance may be taken as an index of the likelihood that, in a humid atmosphere, metal surfaces in contact with these materials may become corroded due to galvanic action or direct chemical attack; this is called the corrosivity index.

2. TEST SPECIMENS

2.1 Plastics. Cured resins, prepared according to the manufacturer's directions or other adequate method, are drilled with a sharp drill at a rate not exceeding 27 feet per minute (0.415-in (1.05 cm) diameter drill at 185 RPM) and the drillings are ground in a Wiley mill. Care shall be exercised not to overheat the material when drilling or grinding as this may change the characteristics of the material. The fraction which passes a 40-mesh screen but is retained by a 60-mesh screen is used for the test.

2.2 Fillers. Fillers shall be used as received from the manufacturer.

3. APPARATUS

3.1 Conductance bridge. A conductance type Wheatstone bridge shall be used which has a range of one to 250,000 ohms measured resistance and which contains a built-in potentiometer, a 1000 $\pm$ 50 cycle per second oscillator, and a sensitive null point indicator. Resistance measurements must be accurate to at least $\pm$ 2 percent.

3.2 Conductivity cell. A dipping type micro conductivity cell for solutions of medium conductance is required. This cell should have a cell constant of 1.0 cm^{-1} and a maximum outside tube diameter of 0.5 in (1.2 cm).

3.3 Sieves. A 40-mesh (420 microns) and a 60-mesh (250 microns) screen is required.

3.4 Constant temperature bath. A constant temperature bath adjustable to 23 $\pm$ 1°C (73 $\pm$ 2° F) is required.

3.5 Chemical glassware. Pyrex Erlenmeyer flasks (65 ml capacity) with ground glass stoppers, and a 50 ml pipette, are required.

3.6 Oven. An oven adjustable to 71 ± 3°C (160 ± 5°F) is required.

3.8 Stopcock grease. The silicone stopcock grease shall not be water soluble nor contain any water soluble constituents. In a blank determination without any sample, water exposed to the grease when applied to the stopper as in 4.1 shall have a specific conductance less than 7×10^{-6} ohm^{-1} cm^{-1} (Dow Corning silcone grease or equivalent).

3.9 Reagents.

3.9.1 Distilled water. Distilled water, obtained from a copper still and stored at ambient temperature in Pyrex glass bottles, with a measured specific conductance of less than 2.0×10^{-6} ohm^{-1} cm^{-1} is required.

3.9.2 Potassium chloride solution. Reagent grade potassium chloride (0.7463 gram), previously dried at 105°C (222°F) for 24 hours, is dissolved in 1000 grams of distilled water, and the solution is stored in a Pyrex glass stoppered bottle. At 23°C (73°F) the specific conductance of this solution is 0.001355 ohm^{-1} cm^{-1} not including the conductance of the distilled water alone.

4. PROCEDURE.

4.1 Water extract. In each of three Erlenmeyer flasks is placed 0.50 gram (± 0.01 gram) of the sample and 50.0 ml distilled water (pipette). The flasks shall be greased with the silicone grease. The flasks shall be tightly stoppered and agitated until the sample particles are thoroughly wetted. The flasks shall be stored in an oven at 71 ± 3°C (160 ± 5°F) for 288 hours. At the end of the first day of oven storage the flasks are examined to see that no stoppers have become loose or blown off, with consequent loss of liquid (in which event the sample shall be discarded), after which the flasks are agitated in order to break up large aggregates of the sample and to dislodge air bubbles that tend to float particles of the sample thus preventing proper wetting. At the end of 288 hours the flasks are transferred to a constant temperature bath adjusted to 23 ± 1°C (73 ± 2°F). The flasks are again thoroughly agitated and the solids allowed to settle.

4.2 Determination of the cell constant of the conductivity cell. Fifty milliliters of the standard potassium chloride solution are pipetted into each of three Erlenmeyer flasks and the conductivity cell is dipped vertically into the liquid until the bottom edge of the cell rests on the bottom of the flask. The assembly and the solution are brought to 23 ± 1°C (73 ± 2°F) by immersion in a constant temperature bath. The specific resistance in ohms of the KCl solution is measured at 1000 cycles a.c.

4.3 Determination of the resistance of the test samples. The specific resistance of each of the solutions extracted from the test specimens is measured by using the same technique and the same conductivity cell as in 4.2.

4.4 Calculations.

4.4.1 Cell constant. The conductivity cell constant K is given by $K = kR$, where k is the specific conductance of the standard KCl solution [0.001355 ohm^{-1} cm^{-1} for 0.01000 normal KCl at 23° C (73°F)], and R is the observed resistance in ohms of the KCl solution in the cell at the same temperature. (K should be approximately 1.0 cm^{-1}). The three cell constant values from 4.2 will be averaged, e.g.,

$$K = \frac{K_1 + K_2 + K_3}{3}$$

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No single value shall deviate from the mean value by more than 2 percent.

4.4.2 Specific conductance. The specific conductance, L_S, in $ohms^{-1}$ cm^{-1} of the aqueous extract of the sample after 288 hours storage at 71°C (160°F) is obtained as follows:

$$L_S = \frac{K}{R}$$

where:

K = the conductivity cell constant
and
R = the observed resistance in ohms of the extract.

The specific conductance shall be determined for each individual sample.

4.4.3 Conductance rating of plastics. The average specific conductance in $ohms^{-1}$ cm^{-1} of the aqueous extracts of three samples of each material after 288 hours of storage at 71°C (160° F) shall be called the conductance rating of the material and is calculated from the relation:

$$\text{Conductance rating of material } (L_s) = \frac{L_{s1} + L_{s2} + L_{s3}}{3}$$

where L_{s1}, L_{s2}, L_{s3} are the determined specific conductance of the three samples.

4.5 Accuracy.

4.5.1 Variation. Lot-to-lot variation may approach ± 5 percent of the mea of five lots and will increase with increasing conductance rating.

5. REPORT

5.1 Report. The report shall include the data specified in Appendix I (General Requirements) at the end of this section, and the following:

a. Date and time in oven at 71°C (160°F)
b. Date and time out of oven
c. Storage time, in hours, at 71°C (160°F)
d. Cell constant K of conductivity cell
e. Resistance in ohms of each of the three samples. (Resistance measured at 1000 c/s a.c.)
f. Average specific conductance, $L_{s(AVE.)}$ in $ohms^{-1}\ cm^{-1} \times 10^{-6}$
g. Last three items shall be reported in the following manner:

Cell constant	Flask No.	Resistance (R)	Specific conductance (L_s)
K_1 =	1	R_1	L_{s1}
K_2 =	2	R_2	L_{s2}
K_3 =	3	R_3	L_{s3}

Average K = Average L_s = _____

This method is part of Fed. Test Method Std. No. 406a

METHOD 7081
January 4, 19

COMPATIBILITY OF PLASTIC-EXPLOSIVE MIXTURES

1. SCOPE

1.1 Scope. This method is designed for use in determining the degree of interaction between plastics and explosives when in contact, as indicated by the evolution of gas.

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2. TEST SPECIMENS

2.1 Dimensions. The materials shall be reduced in size to pass a 40-mesh screen but to be retained by a 140-mesh screen. The plastic material may be ground, drilled, or shredded, provided it is not overheated or contaminated in the process. All residual solvents, or volatiles, shall be removed. The method used for the reduction of the explosive to the required particle size shall be governed by the sensitivity of the particular explosive. Each sample shall be a composite one, i.e. it shall represent all sections of the parent specimen and in the proper proportions.

3. APPARATUS

3.1 Assembly. Figure 7081A shows an acceptable type of apparatus. It consists of a heating tube attached to a manometer. The heating tube may be made from a 12/18 standard taper ground female joint or equivalent. By sealing the joint about 9 cm from the ground end, a tube is formed having a 2.5-3.5 cc capacity. A 12/18 standard taper ground male joint with a 1-2 mm capillary is sealed to one end of a 1-mm capillary, while the other end is provided with a cup to hold mercury to form a manometer. The 1-mm capillary tubing (115-125 cm long) shall be fashioned as shown in figure 7081A. The apparatus shall be calibrated by determining the volume of the heating tube together with the volume in cc per mm of the capillary manometer tube. A constant temperature bath or other means of providing constant temperature at 100 $\pm$ 1°C, having the appropriate shielding or other safety devices, is also required.

4. PROCEDURE.

4.1 Procedure. Two tenths of a gram of the dried explosive is thoroughly mixed by hand with 0.20 gram of the dried plastic, and the mixture is transferred to the heating tube shown in figure 7081A. (Drierite desiccation at room temperature for 24 hours may be used for drying both materials.) The capillary is connected to the heating tube and secured by means of a clamp. Silicone grease is used to insure a proper seal. After placing 5-7 cc of mercury in the cup at the lower end of the capillary tube, the system is evacuated to a pressure ranging from 5.0-0.7 mm of mercury by connecting a vaccuum pump to the mercury cup. After disconnecting the vaccuum pump, the heating tube, plus that part of the capillary tube immediately next to it, is placed in a bath (or other) at 100°C. Following a period of heating for one hour, the value of Y_1 (See figure 7081B) and the barometric pressure (P_1) are noted. (Volume changes occurring during the first hour of the test are disregarded, and the value Y_1 is taken as the zero reading.) The heating is continued for an additional 48 hours, at which time the final barometric pressure (P_2) and the final reading of the manometer (Y_2) are taken. The net change in manometric reading, (Y), due to gas evolution, is determined as follows:

$$Y_2 - Y_1 = Y$$

The difference (P) between (P_1) and (P_2) is determined, then Y + P = C = mm difference due to gas evolved afer 48 hours at 100°C.

4.2 Thermal stability. The total gas evolved by the sample in terms of cc/g, termed the thermal stability of the sample, is determined as follows:

Thermal Stability = (A B C D) + (A_1 C_1 B_1 C D) = cc gas/gram after 48 hours at 100°C.

Where:

A = volume in cc of hot zone of the system (V + W in figure 7081B minus the volume of the sample).

B = factor to convert from 100°C to standard temperature and pressure (STP), or,

$$\frac{273}{(273 + 100)\ 760} = 0.000963.$$

C = net change in manometric reading due to gas evolution corrected for barometric pressure change.

D = factor necessary to convert weight of sample used into terms of 1 gram.

A_1 = actual (uncorrected) reading, (Y_2), plus cold zone length (or, X + Y_2 in figure 7081B).

B_1 = factor to convert from room temperature to STP or,

$$\frac{273}{(273 + 24)\ 760} = 0.0012095.$$

C_1 = cubic centimeters per millimeter (cc/mm) of capillary as determined by calibration

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4.3 Additional tests. A thermal stability test shall be similarly performed on each of the materials (explosive and plastic) separately, and the volume of gas evolved in each case shall be noted.

5. REPORT

5.1 Report. The report shall include the data specified in Appendix I (General Requirements) at the end of this section, and the following:

(1) The volume of gas produced as result of interaction between the plastic and the explosive, which is termed compatibility, is determined as follows:

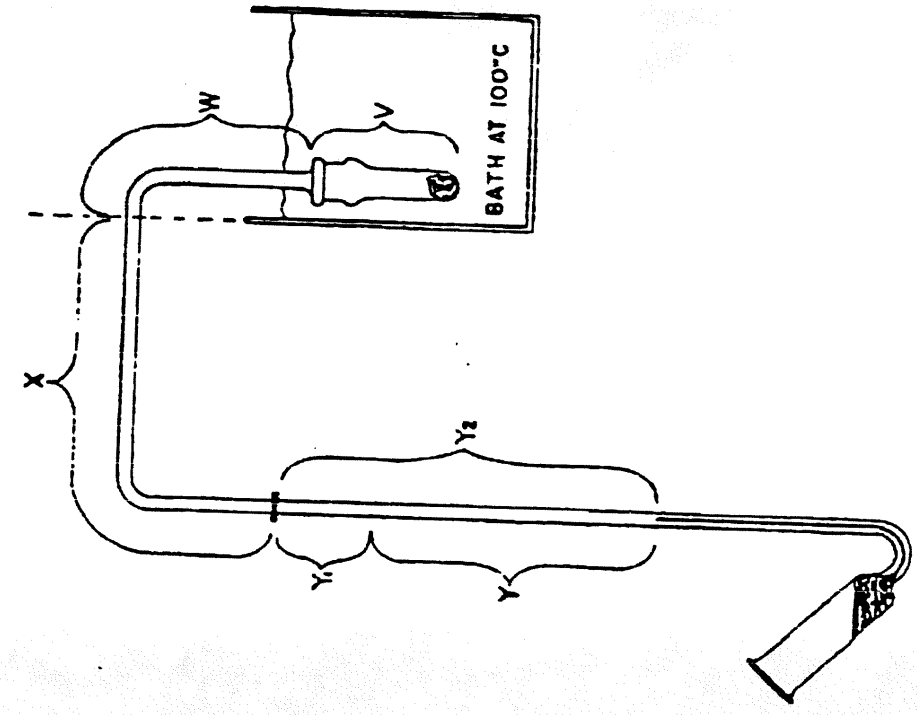
Compatibility = E - (F + G)

where:

E = cc of gas evolved by the plastic-explosive mixture.

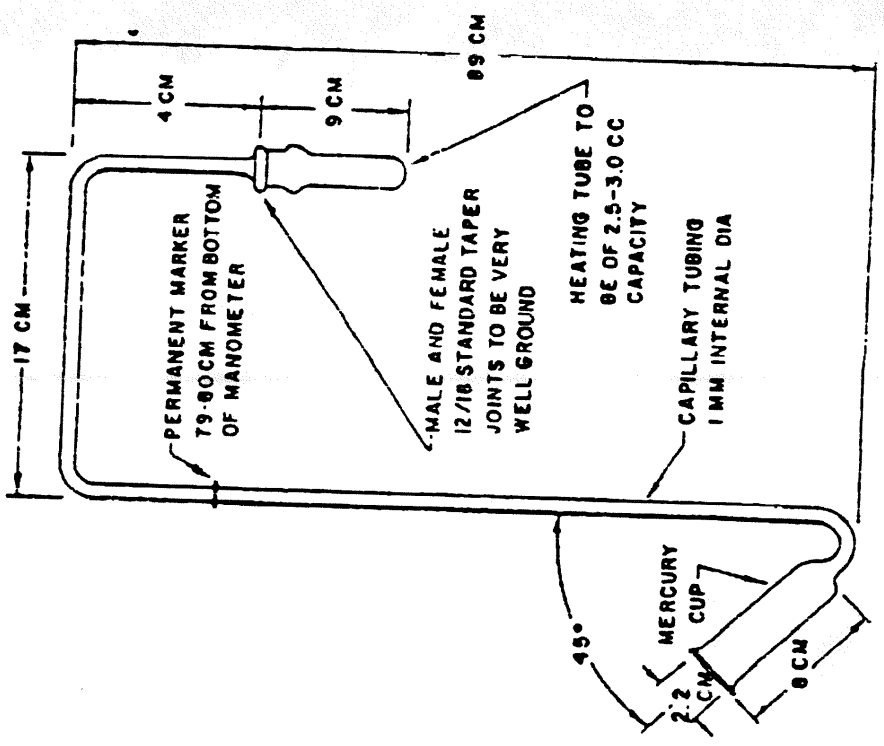
F = cc of gas evolved by the plastic alone.

G = cc of gas evolved by the explosive alone.



SIGNIFICANT ZONES OF APPARATUS

FIGURE 7081B



HEATING TUBE-MANOMETER ASSEMBLY

FIGURE 7081A

APPENDIX I

GENERAL REQUIREMENTS

Test reports. Unless otherwise specified, the report on each test shall include the following:

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(1) The name of the Government agency requesting the test.

(2) The name of the contractor and the number and date of the contract covering the material and/or parts.

(3) The title, number, and date of the applicable specification.

(4) Description of the material, including type, source, manufacturer's code numbers, etc.

(5) Type and dimensions of specimens.

(6) Location and direction of specimens in the original sample.

(7) Temperature, humidity, and length of conditioning period.

(8) Such additional data as are stated herein under the individual test methods.

(9) Such additional data as may be required under the specificatior

(10) Any further information that may be considered pertinent, particularly with reference to unexpected behavior.

(11) A brief description of the testing apparatus, sufficient to identify it.

MILITARY INTERESTS:

Custodians

Army - MR
Navy - SH
Air Force - 11

Review Activities

Army - ME, GL, AR, EA
Air Force - 18
DLA - GS

User Activities

Army - AV
Navy - OS, YD, AS, MC

CIVIL AGENCY COORDINATING ACTIVITIES:

COMMERCE - NBS
GSA - FSS, PCD

PREPARING ACTIVITY:

Army - MR

Project No. 9330-0939

Military Custodians:

Army - MR
Navy - SH
Air Force - 11

Preparing Activity:

Army - MR

Civil Agency Coordinating Activities:
GSA - FSS, PCD
Commerce - NBS

Review Activities:

33/34

Army - ME, GL, AR, EA
Air Force - 18
DLA - GS

User Activities:
Army - AV
Navy - OS, YD, AS, MC

Project No. 9330-0939

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	☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
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